REMARKS

Claims 8, 10, 11, 15-24, 26, 30-35, 42, 43, 45-49, 51-56, 58-60, 64-72, 74-95 remain pending in the above-referenced patent application. Of these, claims 58, 59 and 79 are drawn to non-elected species, and have not been considered on the merits. Applicants respectfully request further consideration of these claims, in view of the amendments set forth above and the following remarks.

Amended Claims

A marked-up version of the amended claims showing the changes thereto is attached as Appendix A.

Claim 92 has been amended to claim a preferred embodiment of the invention. Support for this amendment can be found throughout the specification, including for example at page 50, lines 4-7 and lines 16-17. No new matter has been added.

Acknowledgement

Applicants acknowledge that the Office action has withdrawn the previous rejections under 35 U.S.C. § 112 with respect to claims 93-95.

Rejections Under 35 U.S.C. § 112, 1st Paragraph

Claim 92 has been rejected under 35 USC §112, 1st paragraph as containing new matter – that is, as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that Applicants were in possession of the claimed invention. *See* paragraphs 11-14 at pages 5-7 of the Office action.

This rejection is obviated in view of the amendment to claim 92, considered together with the following remarks.

Applicants respectfully submit that claims 92, as amended, is supported by the entirety of the specification as originally filed, and that a person of ordinary skill in the art would have recognized that Applicants were in possession of the invention defined by this claim.

Support for claim 92 can be found at page 50, lines 4-7, in particular when read in context with page 50, lines 16-17, to wit:

> *Traditional routes* to solid-state synthesis involve the sintering of solid components. *The standard method used to synthesize superconductors*, for example, is to grind several metal-oxide powders together, compress the mixture *and, thereafter, bake at a temperature ranging from 800 °C to about 1000 °C.... In contrast to such traditional routes*, in the present invention, new routes to solid-synthesis focus on the synthesis of compounds *at lower temperatures*.

(emphasis added). Hence, a person of skill in the art would have appreciated that Applicants considered their invention to include preparing semiconductor materials by a method that includes synthesizing (*e.g.*, annealing) at a temperature lower than the traditional, standard sintering temperatures – that is, at a temperature lower than 800 °C.

Accordingly, Applicants submit that this basis for rejection should be withdrawn.

Rejections Under 35 U.S.C. §103(a) – Fister *et al.* in view of Cavicchi *et al.*

The Office action rejects each of the independent claims 42, 68, 70, 72, 74, 84 and 88, together with certain claims dependent therefrom (claims 8, 10, 11, 15-24, 26, 30-35, 43, 45-49, 51-56, 60, 64-67, 69, 71, 75-78 and 80-95) as being obvious under 35 U.S.C. §103(a) over Fister *et al.* (1994) in view of U.S. Patent No. 5,365,756 to Cavicchi *et al.* (*See* paragraphs 17-31 at pages 7-17 of the Office action).[1]

Applicants respectfully traverse this basis for rejection in view of the following remarks.

Each of the independent claims requires forming ten or more different inorganic materials on a substrate by a method that includes (i) delivering a first component of the material to the substrate to form a first solid layer comprising the first component on the substrate, (ii) delivering a second component of the material to the substrate to form a second solid layer comprising the second

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[1] The Office action sets forth numerous conclusive statements regarding what Cavicchi *et al.* teaches with respect to various claimed aspects of the invention, and /or regarding what Applicants claims mean. Applicants expressly disagree with many of the statements asserted in the Office action in this regard. Some particular points of disagreement are discussed herein, to the extent necessary to distinguish the invention defined by the presently pending claims. Applicants have not, however, specifically addressed other particular points of disagreement, since such points are moot in view of the arguments set forth by Applicants. Applicants are not conceding the factual accuracy of any statements set forth in the Office action, except to the extent expressly admitted by Applicants. Applicants do not admit or acquiesce to statements in the Office action upon which Applicants have not commented.

component on the first layer, and (ii) varying the composition, concentration, stoichiometry or thickness of the delivered (first or second) component between respective regions.

The Office action does not set forth a prima facie case of obviousness.

The Combination of the Cited References Does NOT Lead to Applicants Invention

Even if Fister *et al.* and Cavicchi *et al.* are, *arguendo*, considered in combination, they do not disclose or suggest important features of Applicants' invention.

Significantly, for example, neither Fister *et al.* or Cavicchi *et al.* disclose or suggest preparing arrays of diverse materials using a protocol that includes varying the composition, concentration, stoichiometry or thickness of the *delivered* (*e.g.,* first or second) *component, as compared between respective material-containing regions* – a step that is required by each of the claims defining the present invention.

The Office action relies on Fister *et al.* as teaching variation of the composition, concentration, stoiciometry or thickness of the delivered components. *See* paragraphs 19-22 at pages 12-14 of the Office action. However, Applicants respectfully submit that such reliance is misplaced, because each of the claims require that the delivered components be varied as compared between regions. In contrast, Fister *et al.* disclose varying of delivered components sequentially in time, to form the superlattice structure for a single material. The distinction is significant, because it is the variation of delivered components *between regions* that results in the forming of the array of diverse inorganic materials. As acknowledged in the Office action, the Fister *et al.* reference lacks any teaching relating to the preparation of arrays. (*See* paragraph 17 at page 9 of the Office action). Hence, Fister *et al.* does not disclose or suggest *spatial* variation of delivered components – that is, variation of delivered components as compared between different discrete regions of a common substrate.

The shortcomings of Cavicchi *et al.* in this regard are already of record. As detailed in the earlier-filed Amendment D,[2] the Cavicchi *et al.* reference would not have been understood by a skilled artisan as disclosing the required delivery of first and second components in successive layers

[2] *See* pages 17-23 of Amendment D, and especially, page 18 (second full paragraph) through page 22 (first full paragraph).

within each region, while varying the composition, concentration, stoiciometry and/or thickness of the delivered components *between* respective regions. The fact that Cavicchi *et al.* does not make up for the deficiencies of Fister *et al.* with respect to this required feature of the claims appears to have been already acknowledged in the earlier Office action dated August 1, 2001, in which a previous rejection under 35 U.S.C. §102 based on Cavicchi *et al.* was withdrawn. (*See* paragraph 5 at page 3 of the August 1, 2001 Office action). Moreover, the instant Office action does not set forth or note any further teaching in Cavicchi *et al.* with respect to this required claim element.

Other required aspects of certain independent and/or dependent claims are likewise not taught or suggested by the references relied upon in this rejection, including for example: allowing the delivered components to interact under a *common set of reaction conditions* (*e.g.*, claim 72); forming an array of ten or more *composite materials* (*e.g.*, claim 74); and varying the composition, concentration, stoichiometry or thickness of the delivered components *as a gradient* between respective material-containing regions (*e.g.*, claim 84). In fact, the art of record teaches away from at least some of such inventions.

Accordingly, the Office action does not establish obviousness, because technically and commercially significant features of the presently-claimed inventions are not taught or suggested by the prior art relied upon in the Office action. The law is clear that "to establish a *prima facie* case of obviousness, all the claim limitations must be taught or suggested by the prior art." *See* MPEP Sec. 2143.03; *In re Royka*, 180 USPQ 580 (CCPA 1974).

There is No Motivation In the Art to Combine Fister et al. and Cavicchi et al. in a Manner that Would Have Led to Applicants Invention

Additionally, and independently of the aforementioned reasons, *prima facie* obviousness is not established because the Office action does not demonstrate motivation existing in the art that would have led a skilled artisan to combine the teaching of the references in a manner that would have led to the claimed inventions.

In response to Applicants remarks in Amendment E, the Office action articulates that "the test is what the combined teachings of the references would have suggested to those of ordinary skill in the art," and states that "the instant claims are rendered obvious by the various teachings of Fister

with respect to creation of superlattices and Cavicchi with respect to preparing arrays of inorganic materials and screening them to look for materials with desired properties." (*See* paragraphs 24 and 25 at page 15 of the Office action).

However, a person of ordinary skill, considering the Cavicchi *et al.* reference as a whole, would have understood its central teaching as relating to a device for varying specific process conditions – temperature and /or voltage bias, as compared between various regions of the substrate. In contrast, the inventions defined by the presently-pending claims require that one or more of the delivered components are varied with respect to composition, concentration, stoichiometry or thickness as compared between regions. Proactively varying the composition, concentration, stoichiometry or thickness of the delivered components between regions as required by the present invention – rather than varying the particular process parameters as taught by Cavicchi *et al.* – results in substantial benefits for materials discovery research. Briefly, for materials discovery research, both chemical diversity (*e.g.*, composition) and physical diversity (*e.g.* grain size) can be of substantial importance with respect to effecting commercially-important changes in material properties. Significantly, a substantially larger scope of chemical diversity can be achieved by varying the delivered components (*e.g.* with respect to composition, *etc.*) as taught by Applicants – as compared to that which could be achieved by varying temperature and/or voltage bias as disclosed by Cavicchi *et al.* Hence, the presently claimed methods differ substantially from the protocols disclosed by Cavicchi *et al.*, and offer substantial advantages that were not contemplated by the art relied upon in the Office action.

Moreover, the Office action does not demonstrate how or why the combined teachings of Cavicchi *et al.* and Fister *et al.* would have motivated a person of ordinary skill to arrive at Applicants' invention. Specifically, the Office action does not explain why a person of ordinary skilled in the art would have been motivated (i) to use a superlattice approach to form an array of materials in the format of Cavicchi's device, and also (ii) to modify the teachings of Cavicchi *et al.* in a manner that would have lead to Applicants invention – a method which, unlike Cavicchi *et al.*, leads to an array of materials that have substantial chemical diversity.

The Office action notes that "optimization of process steps, especially with respect to ordering, is within the routine skill of the art." (*See* paragraph 15 of the Office action). However, the difference between the presently claimed invention and that of the combined teachings of the cited art

is clearly not merely one of "process optimization" and has little, if anything, to do with the mere "selection of any order of performing process steps" or with merely to "discover the optimum or workable ranges by routine experimentation."

The Office action also asserts that one of ordinary skill in the art would have desired to combine the teachings of Fister *et al.* with those of Cavicchi *et al.* because of

> the "unique properties" of superlattices taught by Fister et al., the use of such to prepare new compounds and also *the need to have a diversity of materials* to screen for desired properties and *the advantages of the methods of Cavicchi et al.*.

See paragraph 28 at page 16 of the Office action (emphasis added).

This basis for motivation, in particular – the "need to have a diversity of materials" for property screening – appears to be misdirected since, as noted above, the combination of Fister *et al.* with Cavicchi *et al.* would not have led to Applicants' invention (which recites specific method steps that differ from those of the cited art) and it does not effect the same outcome (resulting in an array of materials with substantial chemical diversity, suitable for broad-scope materials investigation). Moreover, to the extent that the Office action attempts to extrapolate the cited basis for motivation in order to derive Applicants' invention, such extrapolated motivation is improperly relied upon, in that it is not derived from the teachings of the cited art. The combined teaching of Cavicchi *et al.* and Fister *et al.* does not fairly teach or suggest the desirability of pursuing the extent of chemical diversity effected by the presently-claimed methods. In fact, portions of Cavicchi *et al.* relied upon in the Office action as establishing motivation makes it abundantly clear that Cavicchi *et al.* contemplates "diversity of materials" only to the extent that such diversity is effected by varying temperature or voltage – specifically-taught process parameters. For example, the Office action characterizes "the advantages of the methods of Cavicchi *et al.*" as being

> the ability to simultaneously *process* hundreds of microsamples *with a range of temperature parameters* would greatly enhance the optimization of the *processes*" and that the "ability to examine many microsamples in delicate micro-probing instruments... would speed the *development* process".

See paragraph 17 at pages 11-12 and paragraph 28 at page 16 of the Office action (citing Cavicchi *et al.* at Col. 14, lines 9-16, emphasis added). Clearly, the above-quoted portion regarding speeding "development" process would have been understood by a person or ordinary skill, in context, as

referring to process development – not a broad-based compositional investigation. As another example, the Office action asserts that

> the (Cavicchi *et al*) reference teaches of gas phase reactants to alter the stoichiometry [*sic*: of] the materials.

See paragraph 17 at page 10 of the Office action (citing the Abstract). However, this teaching appears to be relied on in isolation, and out of context from both the Abstract and specification as a whole. As disclosed in context, the Cavicchi *et al.* Abstract clearly articulates that "(m)aterials are deposited onto *pixels with individually controlled deposition conditions (pixel temperature and bias).* Pixels are also addressed *to control properties [sic: temperature and bias] during post-deposition processing steps* such as heating in vacuum or various gases to alter stoichiometry of a *single* material... ." (emphasis added). Hence, in context, this teaching amounts only to varying the stoichiometry of individual materials to the extent such is accomplished by varying the pixel temperature and bias associated therewith. Accordingly, the Examiner's primary basis for motivation – a need to have diversity of materials and the advantages taught by Cavichhi *et al.* – is deficient under the law since it does not lead to Applicants invention as claimed, and/or amounts to an improper hindsight reconstruction of Applicants invention (relying on Applicants own specification as demonstrating the need for substantial chemical diversity on discrete regions of a common substrate, and the advantages resulting therefrom).[3]

To the extent that the Examiner is extrapolating a more general basis for motivation from the teachings of Cavicchi *et al.*, or is relying on some other more general understanding in the art, Applicants respectfully submit that the asserted motivation resulting from such extrapolation is inadequate to establish a *prima facie* case of obviousness under the law because it is too general to motivate a skilled artisan to arrive at the specific invention defined by the claims at issue. *See In re Fine,* 5 USPQ2d 1596 (Fed. Cir. 1988); *In re Dow Chemical Co.,* 5 USPQ2d 1529 (Fed. Cir. 1988); *In re Geiger*, 2 USPQ2d 1276 (Fed. Cir. 1987).

The Office action repeatedly asserts, in this regard, that

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[3] As noted previously, in fact, Cavicchi *et al.*'s consistent focus on process variation, process optimization and process development would have just as likely led away from Applicants' invention, as specifically defined in the presently-pending claims.

> no specific protocol is instantly claimed, *i.e.,* specific reactants/product and conditions specific for that reactant/product...

See paragraph 21 at page 14, and paragraph 25 at page 15 of the Office action. However, such assertion appears to miss the point, *inter alia* – in that Applicants' protocol is specific in a manner other than naming specific reactants, products and/or process conditions. Applicants are claiming methods for preparing arrays of diverse inorganic materials, and methods for using such arrays for identifying promising new materials, where such methods require specifically-claimed protocols including, for example, delivery of first and second components in successive layers *within* discrete regions of a substrate, while varying the composition, concentration, stoiciometry and/or thickness of the delivered components as compared *between* respective regions. This is a more specific protocol than that to which one of ordinary skill in the art would have been led based on the generalized motivation asserted in the Office action.

In short, Applicants are claiming a substantially different method, with notably distinct and additional advantages, that enables a markedly different end result. As noted below, the differences are commercially significant, as evidenced by the widespread acceptance and implementation of Applicants' method by various types of research organizations across numerous industrial sectors.[4]

For the aforementioned reasons, the Office action does not adequately explain *why* a person of ordinary skill in the art would have been motivated to extrapolate beyond the teachings of both Fister *et al.* and Cavicchi *et al.* in a manner that would have led to Applicants invention, as characterized in the broad claims, and/or in certain dependent claims. Therefore, *prima facie* obviousness is not established.

A Skilled Artisan Would NOT have been Motivated to Modify Cavichhi et al. in a Manner that Would Have Destroyed its Intended Purpose

Applicants' respectfully assert that a skilled artisan would not have been motivated to modify the approach taught by Cavicchi *et al.* using protocols that are explicitly contrary to such approach. It

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[4] In this regard, the Office action's reference to MPEP § 2144 (*see* paragraph 30, at page 17 of the Office action) is not on point, since this is not a situation in which the prior art reference suggests what the inventor has done, but for a different reason or to solve a different problem. As noted above, the combined teaching of the cited art would not have led to the invention as claimed.

is well settled in the law that no suggestion or motivation can be established for proposed modifications to a prior art embodiment, where such modifications would render the prior art embodiment unsuitable or unsatisfactory for its intended purpose. *See* MPEP 2143.02; *In re Gordon,* 221 USPQ 1125 (Fed. Cir. 1984). In the present case, for example, a skilled artisan would not have been motivated to modify the central approach taught by Cavicchi *et al.* – varying temperature and/or voltage bias (or at best, other process conditions) in a manner that would have led to Applicants' invention as defined by claims requiring that the materials deposited on an array are allowed to interact under a *common set of reaction conditions* (*e.g.*, claim 72). Such protocols would have defeated the intended purpose of the Cavicchi *et al.* device and methodology.

Hence, the Office action does not establish that the inventions defined by the presently-pending claims would have been *prima facie* obvious.

Objective Considerations Also Demonstrate Non-Obviousness

The non-obviousness of the inventions defined by the presently pending claims is also demonstrated by additional, objective considerations. Such objective factors must be considered in evaluating the issue of nonobviousness. *See Minnesota Mining & Manufacturing Co. v. Johnson & Johnson Orthopaedics, Inc.*, 24 USPQ2d 1321, 1333 (Fed. Cir. 1992); *Gillette Co. v. S.C. Johnson & Son, Inc.* 16 USPQ2d 1923, 1928 (Fed. Cir. 1990). The import of such secondary considerations has long been recognized. As Judge Learned Hand espoused,

> The most competent workers in the field had for at least ten years been seeking (a solution to the problem)... when it appeared, it supplanted the existing practice and occupied substantially the whole field. We do not see how any combination of evidence could more completely demonstrate that, simple as it was, the change had not been obvious.

L. Hand, *Lyon v. Bausch & Lomb Optical Co.,* 106 USPQ 1, 5 (2nd Cir. 1955) (emphasis added).

The objective secondary considerations of the instant situation provide substantial evidence of the non-obviousness of the claimed invention.

Clearly, consideration of the entire body of prior art directed to inorganic materials synthesis and/or screening that existed prior to Applicants' invention demonstrates that inorganic materials research protocols were based on traditional approaches, involving relatively larger scale material synthesis and screening protocols. Before Applicants invention, the generally-followed fundamental

paradigm for inorganic materials research typically involved *bench scale* research with individual samples or groups of individual samples, followed *pilot plant scale* research for materials and methods optimization, and finally *commercial scale* operations, and had gone substantially unchanged for decades, and arguably for more than a century. This is true despite changes in the research paradigms for other types of materials, such as pharmaceuticals (*e.g.,* small organic molecules) and biological polymers (*e.g.,* proteins, DNA). In contrast, however, Applicants' inventions have resulted in a true paradigm shift, in that inorganic materials synthesis is now widely pursued using high-throughput combinatorial materials research techniques, including the techniques claimed herein, as a way to create a more promising pipeline of materials *prior to* entering bench scale and/or pilot plant scale tests. The mere fact of this paradigm shift in fundamental research evidences non-obviousness of the present invention.

Moreover, Applicants are widely recognized by their scientific peers as enabling an entirely new approach to fundamental materials science research – an approach that is being broadly implemented across many types of organizations (*e.g.,* universities, small businesses, larger corporations) and across many industrial segments (*e.g.,* inorganic catalysis, electrochemistry, superconductors, semiconductors and other electronic-related materials. Such recognition by others that Applicants have pioneered a new approach to research is also evidence of non-obviousness.

Finally, Applicants inventions have been an undeniable commercial success. The claimed inventions have potential for broad applications in research programs across numerous industrial markets, including electronics, phosphors, batteries, electrocatalysts, heterogeneous catalysts, defense, and energy applications. Symyx has successfully implemented collaborative research programs involving execution of the claimed methods for preparing arrays of inorganic materials in many of such industrial markets, including for example for clients such as the U.S. Department of Energy (*e.g.,* thermoelectric materials, magnetic materials), Celanese (*e.g.,* heterogeneous catalysts), Bayer (*e.g.,* heterogeneous catalysts) and several undisclosed partners (*e.g.,* fuel cell electrocatalysts, amorphous metals). Combined, these companies have paid considerable sums for access to Symyx' proprietary research workflows, and part of what they paid for are the methods encompassed by these claims. In addition, Symyx operates a Discovery Tools® business, which includes the sale of instruments, software and know-how for various workflows, and the outlicensing of selected technologies. Recently, Symyx licensed Kurt J. Lesker Co. under certain Symyx patents to

manufacture and sell physical vapor deposition systems specifically adapted to practice the methods of the present invention. It is contemplated that these instruments will also form a key component of larger, comprehensive discovery work flows that will be offered by Symyx Discovery Tools business for inorganic materials discovery in selected market sectors. These activities unequivocally demonstrate the commercial success of Applicants inventions.

As such, in view of the factors noted above, Applicants respectfully submit that the inventions defined by the presently pending claims are non-obvious.

Provisional Obviousness-Type Double Patenting Rejections

Each of the considered claims have been rejected under the judicially created doctrine of obviousness-type double patenting as allegedly being unpatentable over various claims of, independently, U.S. Patent No. 5,985,356 to Schultz *et al.*, and U.S. Patent No. 6,004,617 to Schultz *et al.* (*See* paragraphs 8 and 9 at pages 4-5 of the Office action).

Applicants will consider submitting a terminal disclaimer with respect to obviate each of these rejections, if necessary, once substantive agreement on the merits is reached.

Equivalents

The amendments to the claims and the arguments presented in response to the Office action have been made to claim subject matter which the Applicants regard as their invention. By such amendments, the Applicants in no way intend to surrender any range of equivalents beyond that which is needed to patentably distinguish the claimed invention as a whole over the prior art. Applicants expressly reserve patent coverage to all such equivalents that may fall in the range between applicants literal claim recitations and those combinations that would have been obvious in view of the prior art.

CONCLUSION

In view of the foregoing, Applicants believe all claims now pending in this Application are in condition for allowance. The issuance of a formal Notice of Allowance at an early date is respectfully requested.

Applicants believe that no further fees are required in connection with the instant Amendment F. The Examiner is hereby authorized, however, to charge any necessary and proper fees required in connection with this application, or to credit any refund in connection therewith, to Deposit Account No. 50-0496.

Respectfully submitted,

Date Submitted: Nov. 4, 2002

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APPENDIX A

MARKED UP VERSION INDICATING AMENDMENTS TO THE SPECIFICATION AND CLAIMS, AND INDICATING NEW OR CANCELLED CLAIMS

IN THE CLAIMS

***Changes to the previously-pending claims are as follows:

92. (amended) The method of claim 90 wherein the ten or more different inorganic materials are superconductors, and the method for forming each of at least ten of the materials further comprises synthesis of compounds [annealing] at a temperature lower [of less] than [about] 800 °C.